1994

AIR QUALITY DATA SUMMARY

REGIONAL MUNICIPALITY OF WATERLOO

AND THE COUNTIES OF

WELLINGTON AND BRANT

JANUARY 1996

Ontario

Ministry of
Environment
and Energy

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WELLINGTON AND BRANT

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Ministry of Environment and Energy

Report prepared for:

Ontario Ministry of Environment and Energy

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INTRODUCTION

This report summarizes the results of air monitoring in the Regional Municipality of Waterloo, and the Counties of Wellington and Brant in 1994.

The Ministry of Environment and Energy's West Central Region has conducted monitoring in the area since the early 1970's. The Air Management Program in Ontario is based on controlling man-made emissions to meet ambient air quality objectives, which in turn are based on known effects on health, quality of life or sensitive vegetation, whichever is most stringent. To achieve these objectives, sources of pollution are identified, their emissions evaluated and appropriate control measures are instituted. Ambient air monitoring is used to identify pollution sources, evaluate the need for controls and then determine whether controls have been successful.

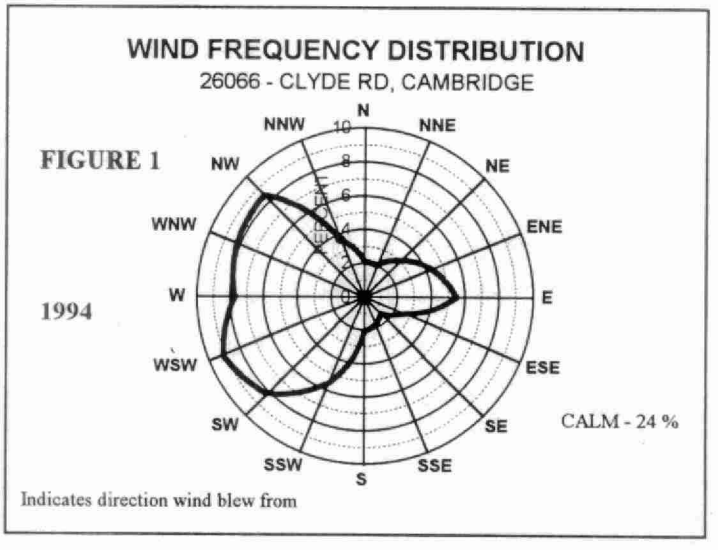
In addition to monitoring specific industrial sources, monitoring of a more general nature is also carried out in various localities to determine if air quality objectives are being met and to observe trends in air pollution.

The Ministry measured the Air Quality Index across the Province at over 30 locations, including Kitchener. A description of the AQI and the 1994 results appear in this report.

MONITORING NETWORK

The Ministry of Environment and Energy's West Central Region operated a network of monitors in Guelph, Kitchener and Elmira. Some of the monitoring was performed near industrial sources, in many cases, as a response to local complaints. Monitoring of a more general nature was also carried out at single stations in Guelph and Kitchener to characterize air quality in larger population centres and to measure the Air Quality Index.

The Ministry has a meteorological tower in Cambridge for measurement of wind speed and direction. Figure I illustrates the typical wind frequency distribution for the area and shows that winds from the southwest, west and northwest quadrants tend to predominate Consequently, wherever possible, fixed stations are located downwind of suspected pollution sources with respect to these winds.



Some of the equipment used in the network is provided by Environment Canada under the National Air Pollution Surveillance (NAPS) program. The instruments are operated and maintained by the Ministry and data from the NAPS stations are provided to Environment Canada.

POLLUTANTS MONITORED

Two basic types of air pollutants are measured - gases and particulates (dust).

a) Gases measured with continuous analyzers include:

Sulphur Dioxide (SO_2) - monitored in Kitchener and Elmira for general ambient levels. SO_2 is a product of fuel combustion. Air quality objectives and their limiting factors are:

1-hour average - .25 ppm (vegetation effects)
24-hour average - .10 ppm (health effects in conjunction with particulates)
1-year average - .02 ppm (vegetation effects)

Carbon-Monoxide-(CO) - general ambient levels are measured in Kitchener. The major source of CO is the automobile. Objectives for CO are:

1-hour average - 30 ppm (health effects)
8-hour average - 13 ppm (health effects)

Ozone (O_3) - measured in Kitchener and Guelph to check general ambient levels. Oxidants are products of photochemical reactions involving oxides of nitrogen, hydrocarbons and sunlight. Ozone accounts for most of the oxidants produced. The sources of the precursor pollutants are mainly industrial and automotive. Concentrations follow very definite trends with highest levels occurring during the summer, and mid-afternoon. Both patterns are directly related to temperature and the amount and intensity of sunlight.

Ozone and its precursors can be transported over great distance and can be augmented by local sources. Most of the high levels in Southern Ontario each summer arrive from the United States. An objective for ozone is:

1-hour average - 80 ppb (vegetation and human health effects)

Oxides of Nitrogen - general ambient levels were measured in Kitchener and Elmira. They are a product of high temperature combustion sources including the automobile. The most abundant oxides are nitric oxide (NO) and nitrogen dioxide (NO_2). Objectives exist only for NO_2:

1-hour average - .20 ppm (odour)
24-hour average - .10 ppm (health effects)

Total Reduced Sulphur (TRS) - measured in Elmira. There is a one-hour TRS objective of 27 parts per billion (ppb), however, it is specifically for areas near Kraft pulp mills. There are no such mills in the Waterloo Region. The TRS measurement includes hydrogen sulphide (H_2S), the "rotten egg" gas as well as other sulphide compounds. A one-hour objective of 20 ppb exists for H_2S (given below). However, H_2S can actually be smelled at 10 ppb or less.

1-hour average - 20 ppb (odour)

b) Particulates (dust) can be measured by three methods, each relating to a different size range of particles.

Dustfall - heavy visible material generally greater than 50 microns in size (one micron is one-millionth of a metre) that settles out of the atmosphere due to gravity. A plastic container is exposed for one month and the collected dust is weighed and expressed as a deposition rate of grams/square metre/30 days. The measurement is imprecise and observations are restricted to relatively local areas. However it is a practical method of measuring the visible dust which often causes complaints. Criteria are:

1-month average - 7.0 g/m^2/30 days (nuisance effects)
1-year average - 4.5 g/m^2/30 days (nuisance effects)

Total Suspended Particulates (TSP) - measured with high volume (hi-vol) samplers near industrial sources and for general ambient observations. The particles range from submicron to about 50 microns in size. The hi-vol sampler draws air through a glass fibre filter for a 24-hour period. The exposed filter is weighed and the weight of the solids collected is converted to an equivalent concentration in air expressed in micrograms per cubic metre. The samplers run once every six days. Criteria based on visibility and health effects are:

24-hour average - 120 ug/m^3
1 year geometric mean - 60 ug/m^3

Soiling Index (Coefficient of Haze) - general ambient levels were measured in Kitchener and Elmira by tape samplers which measure fine particles less than 10 microns. Coefficient of haze tape samplers determine hourly soiling values. Air is drawn through a filter paper tape for one hour. A beam of light is shone through the paper before and after the airborne particles are collected. The difference in light transmission is translated into a coefficient of haze (COH) unit. The paper tape then advances and a new hourly sample is collected. The criteria shown below are based largely on correlations with total suspended particulate (TSP).

24-hour average - 1.0 COH's/1000 linear feet of air
1-year average - .5 COH's/1000 linear feet of air

c) Air Pollution Index (API) - the API has been measured since 1970 and is now incorporated as a subindex of the new air Quality Index (AQI). It is derived from 24-hour average concentrations of sulphur dioxide and soiling index, based on the following equation:

Kitchener

$API = 3.33 (9.1\ COH + 120.8\ SO_2).^{74}$
where:

COH is the 24-hour average soiling index concentration expressed in coefficient of haze units.

SO_2 is the 24-hour average concentration of sulphur dioxide expressed in parts per million.

Air Quality Index (AQI) - the AQI is a more comprehensive information system by which the public can be informed about air quality on a daily and even hourly basis. The index includes the API (described above) which had been in place since 1970. In the AQI, hourly concentrations of sulphur dioxide, soiling index (particles), nitrogen dioxide, carbon monoxide, ozone and reduced sulphur compounds are all converted to a common scale of numbers. In addition to these hourly measurements, 8-hour average levels of carbon monoxide and the API, a function of sulphur dioxide and particles are also included as subindices, making a total of 8 potential subindices measured every hour. The official AQI broadcast is the highest subindex at that time.

The AQI scale is classified as follows:

0 - 15 Very Good
16 - 31 Good
32 - 49 Moderate
50 - 99 Poor
100+ Very Poor

Index levels up to 31 should have little or no effect on people and the environment. Beginning at the moderate level, effects such as odour, vegetation damage and some health effects to sensitive individuals start to occur.

In the poor and very poor categories, these symptoms become more and more acute, such that virtually all people would be hampered in the very poor range.

When moderate levels or higher are measured, public health advisories can be issued to the public along with the actual index number.

The annual 1994 statistics on hourly frequencies in the five concentration categories for four West Central Region stations including Kitchener are presented in Table 1.

As can be seen, ozone (O_3) and soiling index (airborne particulate) were generally the most problematic pollutants across the region. These pollutants and others in the AQI will be discussed in more detail in this report.

TABLE 1
AIR QUALITY INDEX - 1994
HOURLY FREQUENCY DISTRIBUTION

	POLLUTANT	0-15 Very Good	16-31 Good	32-49 Moderate	50-99 Poor	100+ Very Poor
26060 KITCHENER	SO2	8653	0	0	0	0
	COH	8575	92	9	0	0
	O3	8016	614	35	0	0
	NO2	8530	0	0	0	0
	CO	8649	0	0	0	0
	CO8	8649	0	0	0	0
	AP1	8591	104	0	0	0
27067 ST.CATHARINES	SO2	8478	0	0	0	0
	COH	8497	71	11	0	0
	O3	7678	601	13	0	0
	NO2	8574	0	0	0	0
	CO	8538	0	0	0	0
	CO8	8538	0	0	0	0
	AP1	8398	85	0	0	0
27072 NIAGARA FALLS	SO2	8578	0	0	0	0
	COH	8181	51	3	0	0
	O3	7505	738	62	0	0
	AP1	8184	49	0	0	0
29000 HAMILTON DOWNTOWN	SO2	8635	0	0	0	0
	COH	7888	661	107	0	0
	O3	8351	298	13	0	0
	NO2	8654	1	0	0	0
	CO	8318	0	0	0	0
	CO8	8318	0	0	0	0
	TRS	8450	159	39	2	0
	AP1	7128	1412	79	0	0

S02-SULPHUR DIOXIDE
COH-SOILING INDEX
O3-OZONE
NO2-NITROGEN DIOXIDE
CO-CARBON MONOXIDE(1hr)
CO8-CARBON MONOXIDE(8hr)
TRS-TOTAL REDUCED SULPHUR
API-AIR POLLUTION INDEX

Data Analysis

Guelph

Station 28028 in Guelph located at Exhibition Park measures ozone (Figure 2). Table 2 summarizes the data and shows that the hourly objective of 80 ppb was exceeded during 19 hours in 1994, all during the summer. These higher levels generally coincided with equally high readings in other areas across Southern Ontario.

Figure 3 illustrates the trend of annual ozone exceedances and shows fluctation from year to year, largely dependent on the climate of each summer. The volume of emissions of the precursor pollutants - nitrogen oxides and hydrocarbons, is a large factor as well.

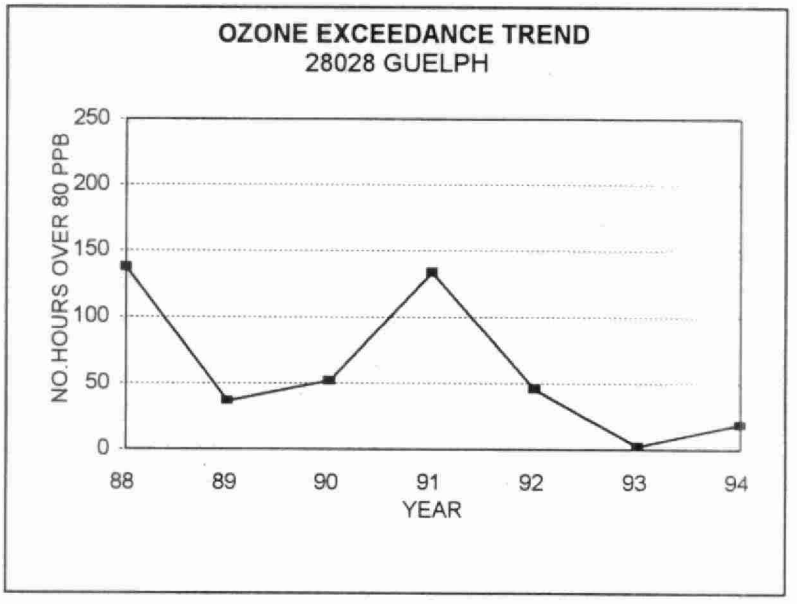


FIGURE 3

As a guide for the public, air quality advisories for ozone were forecast twice during the summer of 1994 in conjuction with Environment Canada. These advisories are forecast a day in advance when it is expected that the ozone objective will be exceeded across particular geographic areas..

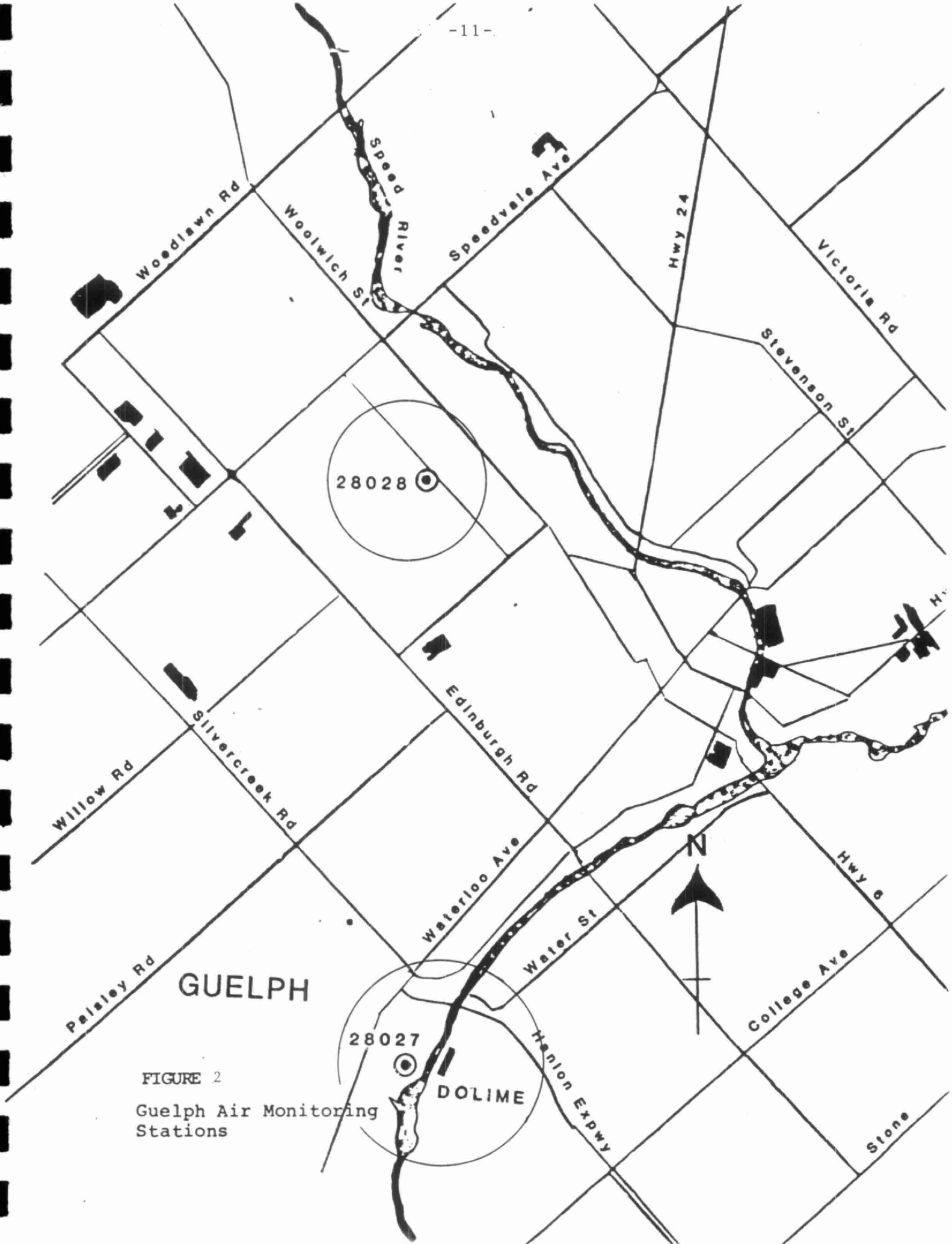


FIGURE 2

Guelph Air Monitoring Stations

Ground level ozone is a photochemical product of the chemical reaction between nitrogen oxides and certain hydrocarbons in the presence of sunlight. The highest levels all occurred during southerly winds and were largely imported from the United States. At these times levels were high throughout Southern Ontario. In recognition of the seriousness of the ozone problem, the Canadian Council of Ministers of the Environment decided in 1988 to develop a management plan for the control of volatile organic compounds (VOC) and nitrogen oxides (NOX) which generate ozone. A three phase program will be undertaken in Canada. The United States is undergoing its own program such that a target date of the year 2005 has been set to resolve the ground level ozone problem. Much concern is expressed also about ozone loss in the upper atmosphere where it is beneficial in reducing ultra-violet radiation. Control measures on chlorofluorocarbons (CFCs) are being implemented, however upper level ozone is not the focus of this report.

The Ministry is taking its own initiatives in combatting photochemical smog. To reduce NOx and VOC, the precursors of ozone, a number of new regulations are being introduced including:

-The requirement for gasoline companies and service stations to install vapour recovery equipment on fuel tanks and trucks (by 1996).
-NOx emissions from stationary turbines must be reduced from 200 ppm to 25 ppm.
-Refineries must produce gasolines which are less volatile during the summer.
-Dry cleaners will be required to undergo education programs by 1996 to minimise their VOC emissions
-Ontario Hydro has already reduced their NOx emissions by 37 kilotonnes in the past 2 years.

Particulates Near Guelph Dolime

Suspended particulates (TSP) measurements were resumed near Guelph Dolime (a limestone quarry operation) at the sewage treatment plant on Wellington Street West. The company had been the source of white dust complaints for several years. The monitor was removed from service in 1990 following the installation of scrubbers on the company's lime kilns, but emission problems led to renewed sampling.

Data are summarized in Table 3 and show average concentrations below the annual objective. The trend graph in Figure 4 shows relatively stable levels during the past few years.

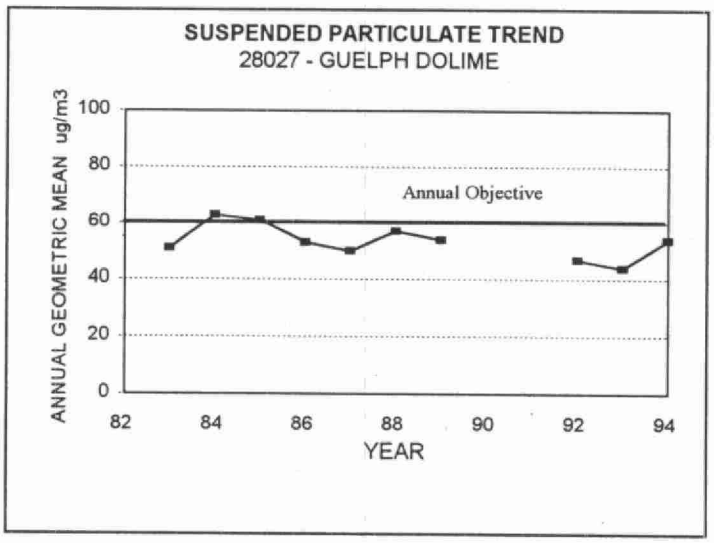


FIGURE 4

There was only one reading out of 45 above the daily TSP objective of 120 ug/m3, but elevated carbonate contents in the samples corresponding to east winds from Dolime suggest that the company can have an impact on particulate levels in the vicinity of the plant. The frequency of TSP exceedances at the measurement location is small - 7 samples out of 169 over three years, however, east winds are not very frequent. The monitor is situated at this location because this historically has been the main impact area. Fugitive emissions including those from plant truck traffic, may contribute to the readings together with stack emissions from the lime kilns.

Modifications to the kiln exhaust system were completed in 1994, however, the Ministry continues to have concerns regarding particulate emissions from this facility. The Ministry will continue to work with the company to reduce emissions. As well, the hivol sampler will be relocated in 1995 in accordance with current complaints and dustfall sampling will be added.

TABLE 2
OZONE - GUELPH

parts per million

YEAR	ANNUAL AVERAGE	MAXIMUM 1 HR	No. of Hours Over Objective
28028 - Exhibition Park			
1994	0.023	0.097	19
1993	0.024	0.084	3
1992	0.023	0.109	46
1991	0.027	0.113	134

Ontario Objective: .08 ppm(1 hour)

TABLE 3
SUSPENDED PARTICULATES NEAR DOLIME

micrograms per cubic metre

YEAR	No. of Samples	GEOMETRIC MEAN	MAXIMUM 24 HR	No. of Samples Over Objective
28027- Hanlon/Speed				
1994	45	54	181	1
1993	45	44	630	3
1992	79	47	180	3
1991	58	54	186	2

Ontario Objectives: 120 ug/m3 (24 hour)
60 ug/m3 (annual geometric mean)

Kitchener

Air monitoring was conducted at station 26060 - West/Homewood in Kitchener (Table 4). The station location is shown in Figure 5.

The station showed acceptable levels of sulphur dioxide (SO_2), soiling index (COH), carbon monoxide (CO) and nitrogen dioxide (NO_2), meeting all criteria. Trend graphs in Figures 6 - 9 for SO_2, CO, NO_2 and COH illustrate mostly declining or stable levels dating back as far as 1977. It should be noted that the move of the station to its present location from the old site adjacent to the Conestoga Parkway caused a major decrease in 1990. Parkway traffic had been influencing the readings up to that time.

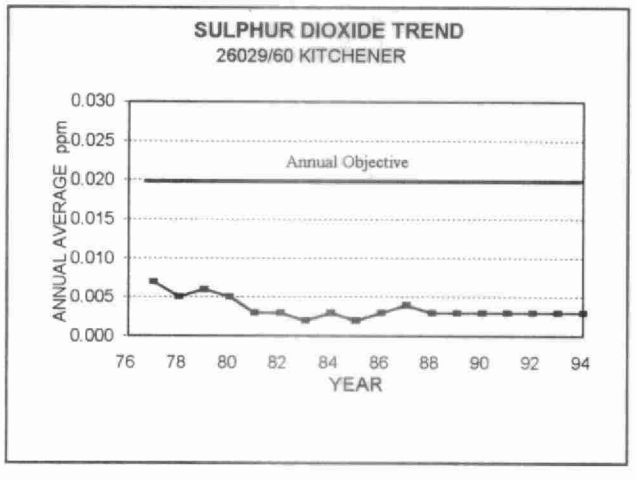


FIGURE 6

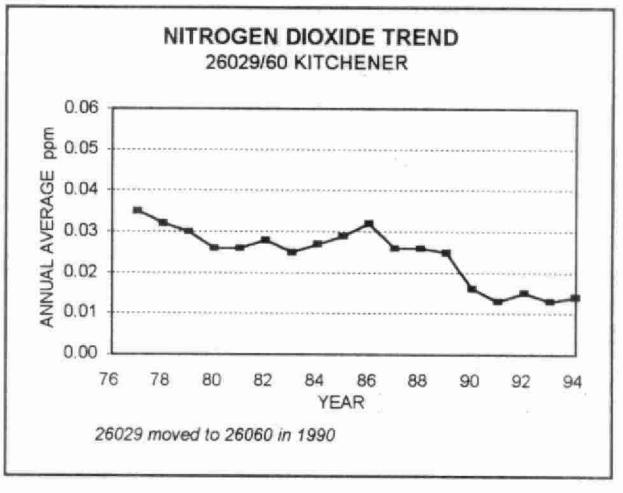


FIGURE 7

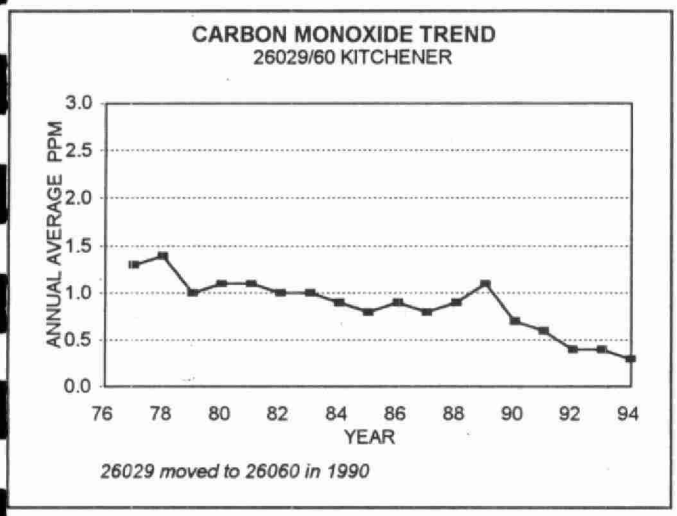


FIGURE 8

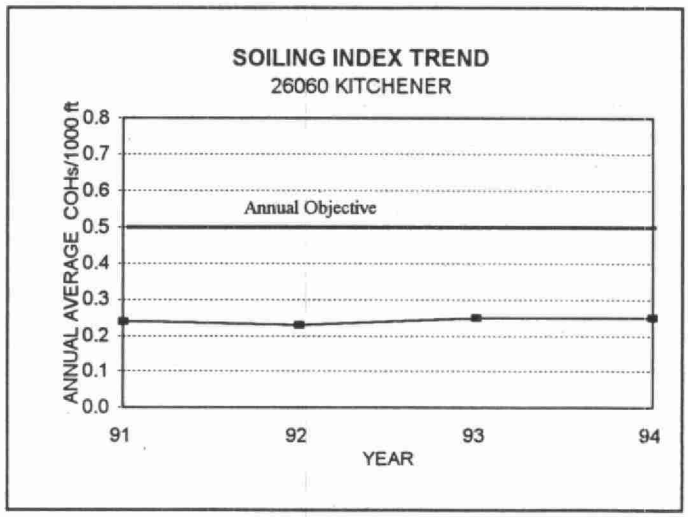
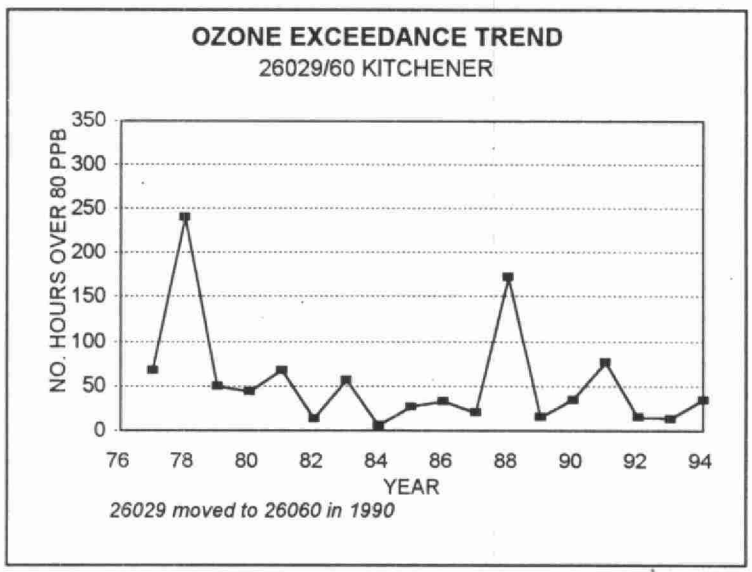


FIGURE 9

FIGURE 10



These data help formulate the Air Quality Index for the city. The data given in Table 1 show that with the exception of ozone (O_3), soiling index (COH) and API, the readings all fall in the Very Good range of the AQI. The higher API readings were driven by the

COH values. The COH displayed 9 hours in the Moderate range, all during rush hours or night time inversion conditions. Traffic was probably the major contribution to these readings.

The Kitchener station measured 35 hours above the hourly ozone objective of 80 ppb in 1994, all falling in the Moderate range of the AQI. Trends in ozone are shown in Figure 10. Random variations tend to occur from year to year, largely dependent on the climate of each summer. Information on ozone and control programs is given in the Guelph section of this report.

FIGURE 5

KITCHENER AQI STATION

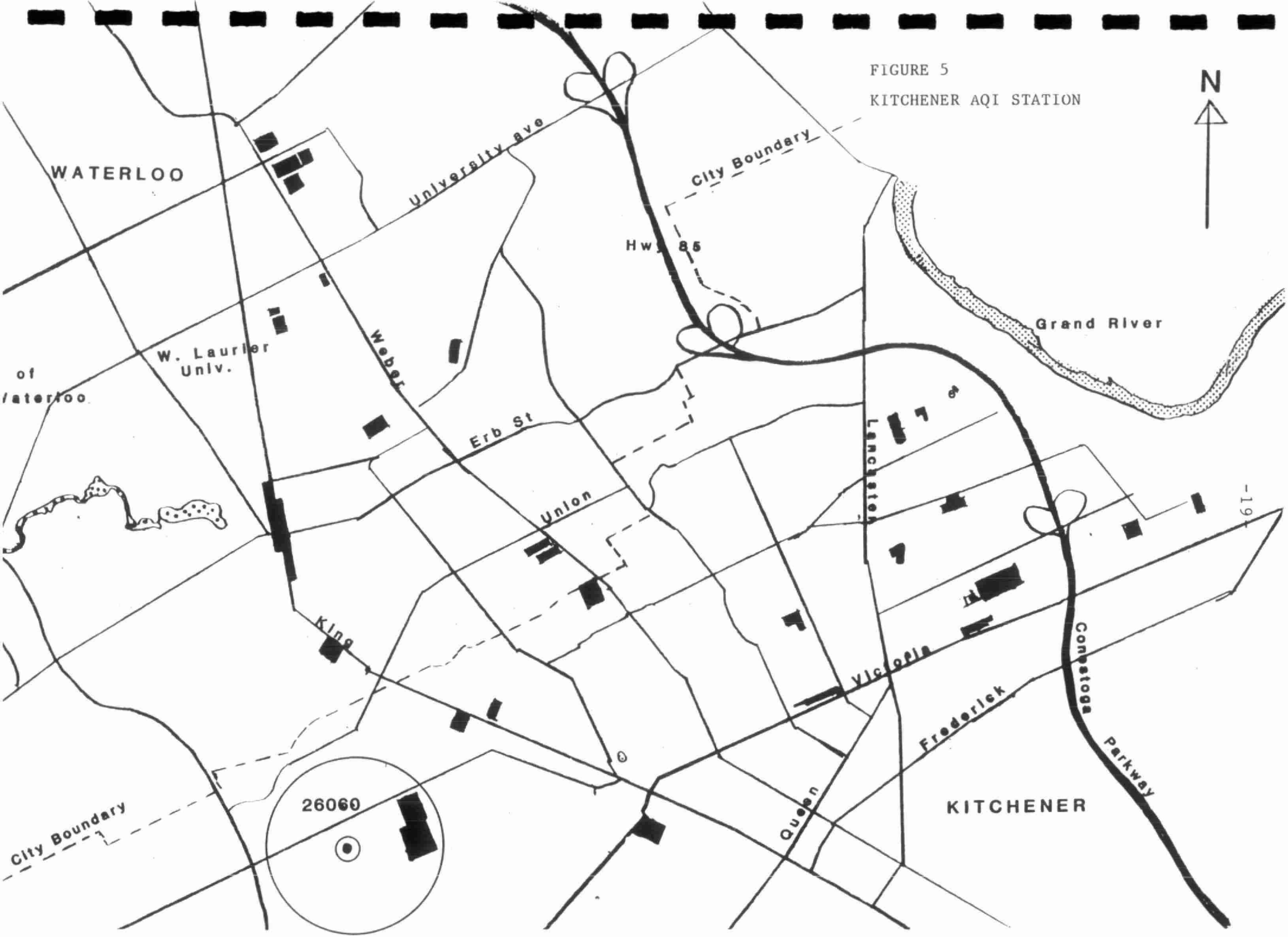


TABLE 4

KITCHENER - CONTINUOUS POLLUTANTS

26060 - WEST/HOMEWOOD

POLLUTANT	YEAR	AVERAGE	MAXIMUM			OBJECTIVES				No. Times Over Objective		
			1 HR	8 HR	24 HR	1 HR	8 HR	24 HR	1 YR	1 HR	8 HR	24 HR
SULPHUR DIOXIDE	1994	0.003	0.04		0.02					0		0
SO2 - ppm	1993	0.003	0.06		0.02	0.25		0.10	0.02	0		0
	1992	0.003	0.07		0.04					0		0
	1991	0.003	0.06		0.02					0		0
SOILING INDEX	1994	0.25			1.2							1
COHs/1000ft	1993	0.25			0.8			1.0	0.50			0
	1992	0.23			0.7							0
	1991	0.24			0.8							0
CARBON MONOXIDE	1994	0.3	9	5						0	0	
CO - ppm	1993	0.4	7	5		30	13			0	0	
	1992	0.4	6	3						0	0	
	1991	0.6	10	5						0	0	
NITROGEN DIOXIDE	1994	0.014	0.07		0.04					0		0
NO2 - ppm	1993	0.013	0.10		0.04	0.20		0.10		0		0
	1992	0.015	0.06		0.04					0		0
	1991	0.013	0.07		0.04					0		0
OZONE	1994	0.024	0.094							35		
O3 - ppm	1993	0.023	0.093			0.08				14		
	1992	0.023	0.099							16		
	1991	0.027	0.118							77		

Elmira

Station 26069 - Park/Duke (Figure 11) measured sulphur dioxide, nitrogen oxides, total reduced sulphur (TRS) and soiling index continuously and volatile organic compounds (VOC) on an every 12th day schedule basis.

Concentration summaries of the continuous parameters are given in Table 5 and showed low levels of all the contaminants, mostly below criteria and generally unchanged from 1993 levels.

In the past, sulphur dioxide levels occasionally became briefly elevated (but below objectives) due to emissions of Sulco Chemicals Ltd., a sulphuric acid manufacturer 600 metres southeast of the station. The company was given a Certificate of Approval to raise its main stack, which was carried out in April 1994. This measure helped to significantly reduce the incidence of short term SO_2 levels at station 26069.

The only other parameter of significance was total reduced sulphur. The hourly objective for hydrogen sulphide (H_2S) of 20 ppb was exceeded 8 times and there were 25 other hours that were over 10 ppb - the approximate odour threshold for H_2S. These readings almost all occurred during calm wind conditions during night or early morning hours making the wind direction indication unreliable. However, the slight wind indications before and after the events were generally east or southeast, so it is possible that Uniroyal was the source. The incidents started in late July 1994 and are continuing to the present. The Ministry has not received any added complaints regarding these occurrences and the source causing them remains unknown.

There was one abnormal TRS event on September 23 when two consecutive hours measured 109 and 148 parts per billion. Uniroyal was conducting a drum excavation at the time and this released carbon disulphide to the air. The station was directly downwind. The readings were above the hourly carbon disulphide objective (about 100 ppb) which is based on odour.

The main air pollution problems in Elmira relate to organic chemicals, which sometimes create odour. Station 26069 measured volatile organic compounds (VOC) on an every 12th day schedule (midnight to midnight). The monitoring methodology involves drawing a measured volume of air through a glass cartridge containing an adsorbent material. The sample is then desorbed and analyzed by gas chromatography at the laboratory. A total of 29 compounds are measured and summary statistics for the 1994 measurements are given in Table 6.

Concentrations of all the contaminants were generally low and well below the relevant criteria. One pollutant, toluene, was dominant when winds were from the east, from Uniroyal Chemicals Ltd. The toluene concentrations in the regular samples peaked at 74 ug/m^3, however, this elevated reading and others were imprecise, as laboratory equipment was not calibrated to operate in such a concentration/mass range. In order to reduce the mass loadings, a few samples have been run over half hour periods to get a more accurate concentration level. These samples were run during east wind conditions. One of those samples showed a toluene peak of 131 ug/m^3 (in 1993), far below the standard of 2000, but well above normal levels.

The company is committed to an abatement program which will reduce their toluene emissions, as well as other chemical emissions.

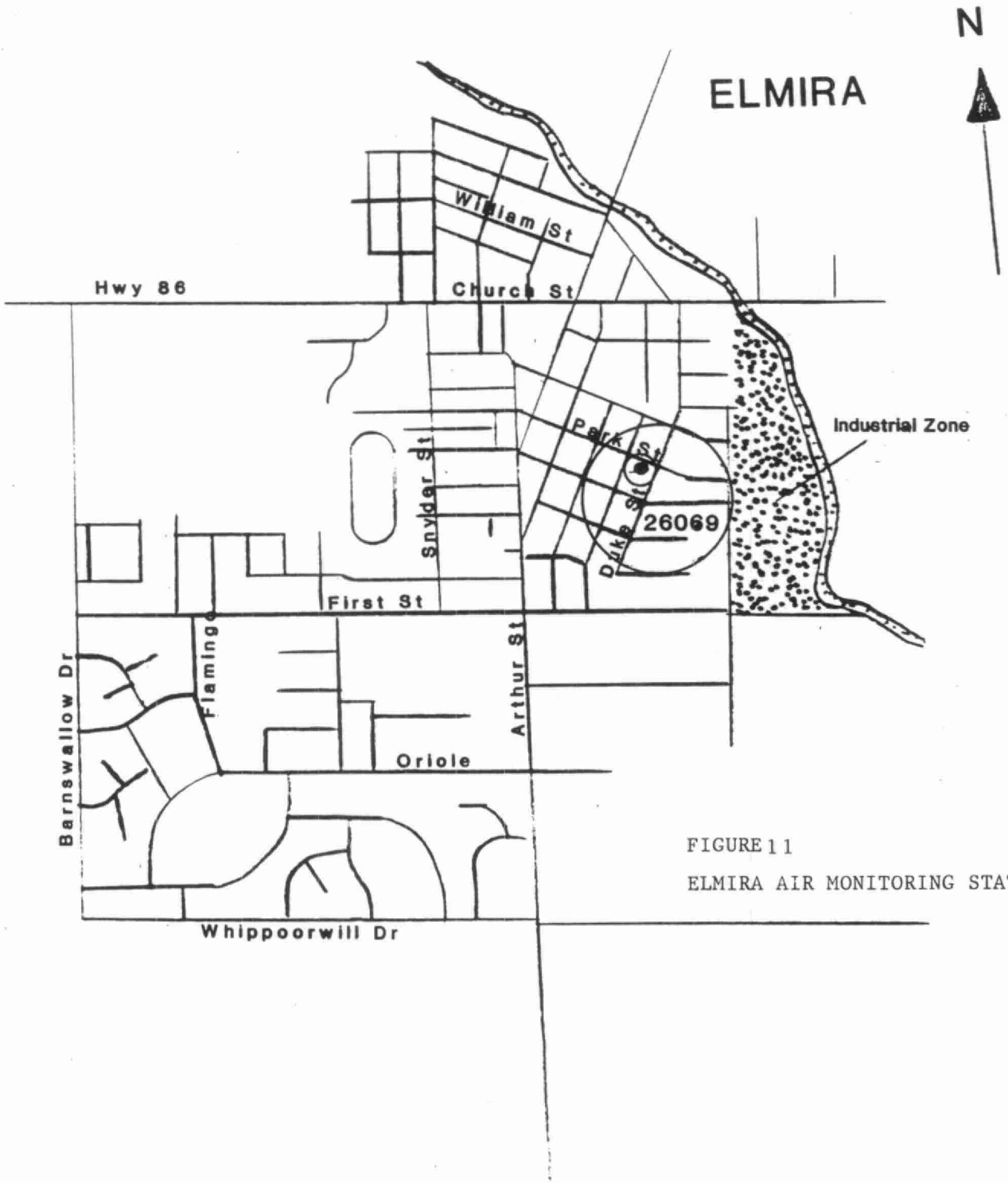


FIGURE 11

ELMIRA AIR MONITORING STATION

TABLE 5
ELMIRA - CONTINUOUS POLLUTANTS
26069 - PARK/DUKE

POLLUTANT	YEAR	AVERAGE	MAXIMUM		OBJECTIVES			No. Times Over Objective	
			1 HR	24 HR	1 HR	24 HR	1 YR	1 HR	24 HR
SULPHUR DIOXIDE	1994	0.004	0.17	0.03	0.25	0.10	0.02	0	0
SO2 - ppm	1993	0.003	0.17	0.04				0	0
SOILING INDEX	1994	0.20		0.9		1.0	0.50		0
COHs/1000ft	1993	0.22		0.8					0
NITROGEN DIOXIDE	1994	0.009	0.11	0.04	0.20	0.10		0	0
NO2 - ppm	1993	0.009	0.08	0.03				0	0
TOTAL REDUCED SULPHUR	1994	0.8	148		20			8	
TRS - ppb	1993	0.7	13		(H2S)			0	

TABLE 6
VOLATILE ORGANICS (VOC) - 1994

micrograms per cubic metre

26069 - Duke/Park, Elmira

	24 HR GUIDELINE	No of Detects	Average 1994	Average 1993	Max 1994
VINYL CHLORIDE	1	1			
1,3-BUTADIENE		6	0.1	0.1	0.1
ISOPRENE		15	0.1	0.1	0.4
1,1-DICHLOROETHENE	35	21	0.2	0.2	0.6
ACRYLONITRILE	100	0			
DICHLOROMETHANE	1765	23	2.4	0.4	18.0
1,1-DICHLOROETHANE		1			0.2
HEXANE	12000	23	1.0	0.7	2.6
TRICHLOROMETHANE	500	10	0.1	0.2	0.1
1,2-DICHLOROETHANE	400	0			
CYCLOHEXANE	100000	21	0.1	0.1	0.3
CARBON TETRACHLORIDE	600	23	0.5	0.5	1.1
BENZENE		23	1.2	0.8	2.2
TRICHLOROETHYLENE	28000	13	0.1	0.1	0.3
1,1,1-TRICHLOROETHANE	115000	23	2.5	2.8	4.2
1,2-DICHLOROPROPANE	2400	0			
BROMODICHLOROMETHANE		2			0.1
CIS-1,3-DICHLOROPROPENE		0			
TOLUENE	2000	23	17.8	15.6	74.0
1,1,2-TRICHLOROETHANE		0			
CHLOROMETHANE		0			
TETRACHLOROETHYLENE	4000	21	0.2	0.2	0.4
CHLOROBENZENE		3			0.1
ETHYLBENZENE	4000	23	0.6	0.6	1.4
M-XYLENE	2300	23	2.0	2.7	5.3
STYRENE	400	12	0.2	0.1	1.1
O-XYLENE	2300	23	0.7	0.8	1.9
1,1,2,2-TETRACHLOROETHANE		1			0.1
a-PINENE		11	0.2		0.4
1,3,5-TRIMETHYLBENZENE		22	0.3	0.2	0.9
1,2,4-TRIMETHYLBENZENE	1000	23	0.8	0.7	2.8
1,3-DICHLOROBENZENE		1			0.1
1,4-DICHLOROBENZENE		18	0.2	1.1	0.5
1,2-DICHLOROBENZENE	30500	0			
NAPHTHALENE	22.5	21	0.3		0.8

SUMMARY

This report has summarized the results of ongoing air monitoring in the Waterloo and Wellington areas. Industries causing air pollution problems have initiated or completed abatement programs to reduce their emissions.

General air quality as characterized by stations in Guelph, Kitchener and Elmira was generally very good, with the exception of ozone episodes during the summer, which were common to the rest of Southern Ontario.

Long term programs in Canada, Ontario and the United States are being implemented to overcome the ground level ozone problem, but as an interim measure there is a joint Federal/Provincial initiative to forecast high ozone days in the summer in routine weather reports. The public is advised that sensitive individuals may experience respiratory symptoms and should alter their activities accordingly. The public will be encouraged to refrain from strenuous exercise, reduce their use of automobiles, to car pool, to use public transit and to avoid the use of oil based paints and solvents and gasoline powered equipment such as lawn mowers.

Much of the air monitoring is automated and linked via a Province-wide telemetry system. The system permits all of the Ministry's stations with continuous analyzers to send data directly to a central computer facility in Toronto allowing for data availability on a real-time basis. This system allows for immediate access to data in Hamilton and in Toronto, and also allows for remote control and maintenance of the instruments. All of this results in a more efficient monitoring program.

One purpose of the telemetry system is to facilitate the Air Quality Index (AQI). The AQI is a function of six different pollutants, which form up to eight separate subindices. Concentrations of sulphur dioxide, soiling index, carbon monoxide, nitrogen dioxide, total reduced sulphur and ozone are all individually converted to a common scale of index numbers with the same advisory or alert levels as the previous API i.e., 32, 50, 75 and 100. Not all stations measure all of the parameters, but the highest hourly subindex is reported several times daily to the public. The pollutant measured by this subindex may also be identified. The intent of the new index is to better inform the people of Ontario of air quality in their local area in a way which is quick and easy to understand.

DATE	ISSUED TO